2. That the admixture of the vapour of carbon bisulphide does not sensibly lower the igniting point of coal-gas, although alone, or mixed with hydrogen or carbonic oxide, this vapour inflames at 400° F. 3. The Davy lamp, which is a protection in explosive mixtures of air and firedamp, is not safe in similar mixtures of air and coal-gas.

The third paper in the section discusses the possibility of making metallic magnesium available as a source of artificial light: and the last paper, relating to the use of illuminating materials, describes the construction of a gas-burner, in which the waste heat of the flame is made to raise the temperature of both air and gas to 500° or 600° F. before combustion, and thus to increase the luminosity of the flame.

The author's group of papers on water examination and purification, and on the treatment of sewage and other refuse, occupies nearly 300 pages of the volume before us. The value of Dr. Frankland's investigations in sanitary chemistry has been variously estimated, and a glance over the pages before us recalls the wordy warfare that has been waged between the upholders of Dr. Frankland's system of water analysis and of the conclusions founded upon the data afforded by it, and those that put their trust in the method devised by Messrs. Wanklyn, Chapman, and Smith. We anticipate that the republication of Dr. Frankland's papers will impart fresh vitality to a controversy that seemed, happily, to be on the wane. If, however, a renewal of the controversy is likely to lead to re-investigation and substantial improvement in the existing methods of water analysis, we shall not regret the re-opening of the subject.

The chief aim of all modern methods of water analysis is the detection and estimation of organic (especially sewage) contamination. Dr. Frankland seeks to attain the end in view by direct estimation of the "organic" carbon and nitrogen in the water, while Messrs. Wanklyn, Chapman, and Smith attempt to estimate the nitrogenous organic matter in water by breaking up the organic bodies and separating their nitrogen in the form of ammonia—"albumenoid ammonia." A rather extended experience in the use of both methods has led us to conclude that Dr. Frankland's plan, though nearly perfect in point of theory, is not as satisfactory in practice; while the rival method rests on a bad foundation, but is not likely to lead to error in excess. We may state this much without trenching too far upon technical ground, but we do so in order to justify the desire above expressed for a re-investigation of the subject, conducted with a view to render the theory and practice of water analysis equally satisfactory.

It is scarcely necessary to mention that we find in this section Dr. Frankland's valuable papers on the development of fungi in potable water; on the deterioration of potable water during its passage through cast iron mains and leaden service pipes; on the methods of softening "hard" water, and on the comparative purity of water from various geological strata, and from different sources such as mountain streams and lakes, rivers, shallow wells, artesian wells, and springs. In addition, experimental data are given showing the extent to which polluted water can be purified by various means and rendered fit for domestic purposes. These papers, together with those on sewage treatment, are of especial value to sanitary engineers, and will no doubt be more freely consulted in their present well-connected form than when scattered through other publications.

In Section III. Dr. Frankland returns to gases and vapours—evidently favourite subjects of study with him since the date of his discovery of the alcohol radicles—but now from the physical side. The first investigations detailed in the section are those upon the effect of pressure on combustion, which led him to conclude that the luminosity of ordinary flames] is chiefly due to the presence of incandescent vapours or gases of high density, rather than to solid particles. The author's experiments on the combustion of hydrogen and carbonic oxide under great pressure proved that incandescent gases and vapours emit light in proportion to their density, and that a continuous spectrum can be afforded by dense gas as well as by solid or liquid matter. These observations led to the suspicion that the sun's photosphere consists of gases or vapours only, and ultimately to the commencement of a new line of research in conjunction with Mr. J. Norman Lockyer, who was then engaged on his researches on the physical constitution of the sun. Dr. Frankland was soon obliged to relinquish the investigation, owing to pressure of other work; but in Mr. Lockyer's hands it has since afforded results of the highest interest and value.

Excluding a chapter on climate, and some miscellaneous observations, the last research detailed in the volume before us is a highly important one on the source of muscular power. This inquiry is really complementary to the well-known investigation of Profs. Fick and Wislicenus on the same subject, for Dr. Frankland ascertained by direct calorimetrical determinations the potential energy locked up in muscle and in its chief products of oxidation—urea, uric acid, and hippuric acid—and proved that the store available was much less than would suffice to account for the work done by Fick and Wislicenus in the ascent of the Faulhorn. Frankland's experiments conclusively proved that the muscular force expended by the two professors in the ascent of the mountain must have been chiefly derived from the oxidation of non-nitrogenous matters, since it could not have been produced by the oxidation of muscle or other nitrogenous constituents of their bodies. This investigation is one of the most valuable in the section, and will be re-read with special interest in connection with the Rev. Prof. Haughton's latest researches.

We cannot conclude this short sketch of Dr. Frankland's admirable researches without giving expression to the hope we entertain that the well-arranged volume before us may prove to be but an instalment of the life-work of its distinguished author.

J. EMERSON REYNOLDS

FLORA OF TROPICAL AFRICA

Flora of Tropical Africa. By Daniel Oliver, F.R.S., F.L.S., Keeper of the Herbarium and Library in the Royal Gardens, Kew, and Professor of Botany in University College, London. Assisted by other botanists. Vol. iii. Umbelliferæ to Ebenaceæ. Published under the Authority of the First Commissioner of Her Majesty's Works. (London: L. Reeve and Co., 1877.)

THE third volume of Oliver's "Flora of Tropical Africa" includes fourteen natural orders, mostly belonging to the sub-class Gamopetalæ of the Dicotyle-

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dons. The two orders, Umbelliferæ and Araliaceæ, both by Mr. W. P. Hiern, and occupying the first thirty-two pages, were printed in 1871 along with vol. ii., the rest being all new. The district included in the present volume is of course the same as that mentioned in the previous ones, extending on each side of the equator for somewhere about fifteen degrees. It is divided into six regions, two on the west side of the continent, distinguished as Upper and Lower Guinea, two on the east side; Nile Land and Mozambique and the intervening region divided into the north and south-central. The district is therefore one of vast extent, and will probably yield many new forms when further exploration renders our knowledge of the country and of its productions more complete than it is at present.

The Umbelliferæ are represented in the flora by twenty-one genera and about forty-four species. The number of genera is small when contrasted with the thirty-four found in Britain. Several familiar British forms are found in this flora, of which it will only be necessary to mention *Sanicula europæa*, *Conium maculatum*, *Anthriscus sylvestris*, *Daucus carota*, and *Caucalis infesta*. Five genera are, however, endemic in Africa. The genus *Peucedanum* is interesting as including two species, *P. araliaceum* and *P. fraxinifolium*, both small glabrous trees. The Araliaceæ are unimportant, and represented by only three genera and fourteen species.

By far the most important monograph in the present volume is that on the Rubiaceæ, by Mr. W. P. Hiern. It occupies over 200 pages, or nearly as many as the monograph of the Compositæ, the joint production of Messrs Oliver and Hiern. The Rubiaceæ form a very extensive tropical and sub-tropical order, most richly represented in America. Tropical Africa, however, possesses seventy-eight genera, about thirty of which are endemic, and three of these are now described for the first time by Mr. Hiern. The genus *Coffea* is fully treated of by Mr. Hiern. The *C. arabica* occurs in four of the districts of the flora, but not in the two Central regions. The new coffee, *C. liberica*, Hiern, which promises to be of so much value, is here noticed. It is the source of the Liberian coffee, and probably of the Cape Coast coffee. The berries are said to be larger, the flavour finer, and at the same time the plant is more robust and productive than the ordinary *C. arabica*. The *C. arabica* has the flowers pentamerous, while in *C. liberica* they are 7- or 6-merous; or, according to the key to the species, 6 to 8-merous. The genus *Sarcocephalus* is an interesting one, the fruits cohering to form a pseudocarp known as the peach, or country fig, of Sierra Leone. The shape and colour of the pseudocarp is that of a strawberry, but in flavour it resembles an apple. Unfortunately if eaten to excess it acts as an emetic. Two familiar species of *Galium* are also included in the flora, namely, *G. aparine* and *G. mollugo*.

The Valerianaceæ are represented by the European *Valerianella dentata* only. The Dipsaceæ by three genera, *Scabiosa* yielding two familiar species. Both these small orders are by Mr. Hiern.

The Natural Family Compositæ, the joint production of Prof. Oliver and Mr. Hiern, occupies the chief place in the volume, as would be expected of the largest order of flowering plants. The number in the tropical region of Africa, 468 species, is small compared with the 1,300 species occurring in the Cape flora. In tropical Africa there are 117 genera, seventeen being endemic, and all of these latter either small or monotypic. Many of the forms are of great interest, and some of the genera very extensive. It is curious to meet with *Erigeron alpinus* in Abyssinia, along with *Senecio vulgaris*, and others, some of them familiar weeds. The genus *Tarchonanthus* forms a small tree, and it was upon a species of this genus that Dr. Welwitsch found the only species of *Viscum* he met with in Angola.

The Campanulaceæ are by Mr. W. B. Hemsley, who reduces the peculiar Abyssinian plants known as *Tupa* to the genus *Lobelia*, and describes two species, *L. rhynchopetalum* and *L. giberroa*. One species of *Lightfootia*, from Lower Guinea, is of interest. In it (*L. welwitschii*) the ovary is almost wholly superior, while in all others the ovary is inferior, the plant thus looking very unlike the other members of the Campanulaceæ. Four genera of Ericaceæ occur, but only one species of *Erica*, viz., *E. arborea*, thus contrasting with the Cape flora where the species are most numerous. The Ericaceæ, Plumbagineæ, and Primulaceæ are by Prof. Oliver, but are small and unimportant. The Myrsineæ and Sapotaceæ are by Mr. J. G. Baker, and the Ebenaceæ by Mr. Hiern, who has already published a monograph of this group.

The greater part of the volume is by Mr. Hiern, who contributes about 270 pages, while, along with Prof. Oliver, he contributes 207 pages more. About twenty pages each are contributed by Messrs. Baker and Hemsley, while eight only are from the pen of Prof. Oliver alone. This handsome volume of about 550 pages adds another to the long series of "Floras" now so well known and so highly appreciated that have from time to time issued from Kew. W. R. McNab

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Marine Fossils in the Gannister Beds of Northumberland

I TAKE the earliest opportunity to announce, through your columns (if you will allow me to do so), that on the 9th of this month (February), while conducting the usual weekly field-work in connection with this college, I had the good fortune to find marine fossils in the lower coal measures, or gannister beds of Northumberland. The locality is about half-way between the Stocksfield Station, on the Newcastle and Carlisle Railway, and the village of Whittonstall. As I have more than once insisted on the fact that hitherto no marine forms had been found in this series in this country, I wish to be the first to destroy the effect which that negative evidence may have produced. The importance which the study of the gannister fauna has assumed since the publication of Prof. Hull's recent paper on the Classification of the Carboniferous Rocks in the *Quarterly Journal of the Geological Society*, need not be dwelt on.

Full details of the find will be published elsewhere.

G. A. Lebour

College of Physical Science, Newcastle-on-Tyne, February 12

Liquids having a Specific Heat Higher than Water

IN NATURE, vol. xvii. p. 252, it is stated: "Hitherto water has been regarded as possessing a greater specific heat

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